HIGH APERTURE OBJECTIVE OF THE GAUSS-TYPE

Filed April 4, 1960
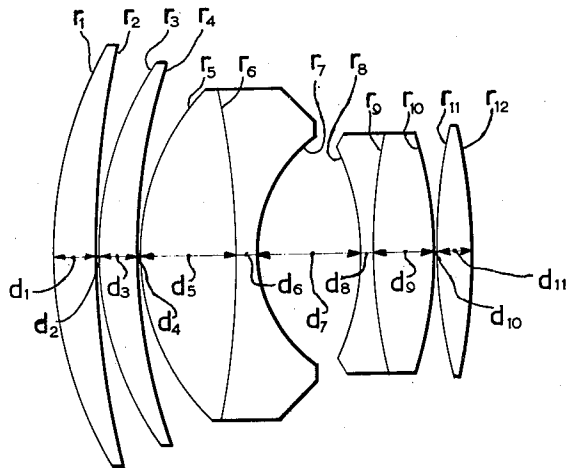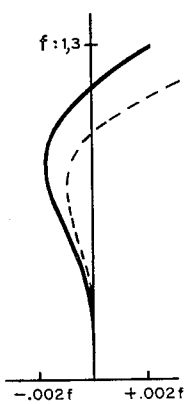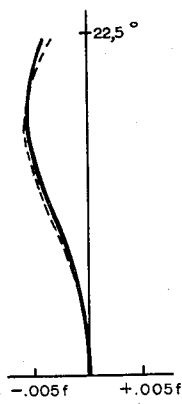

Fig.1

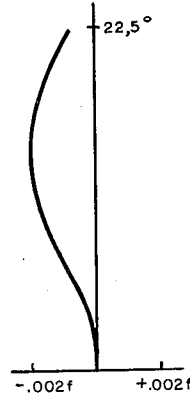Fig.2   Fig.3   Fig.4

INVENTOR.

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BY

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Attys.

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2,985,071

HIGH APERTURE OBJECTIVE OF THE
GAUSS-TYPE

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Filed Apr. 4, 1960, Ser. No. 19,625

Claims priority, application Netherlands Apr. 9, 1959

1 Claim. (Cl. 88—57)

The invention relates to an objective of the Gauss-type
which has a large relative aperture and is made up of
five components comprising seven elements, viz. from the
front towards the rear:

(a) A single convergent meniscus front lens which is
convex towards the front;

(b) A single convergent meniscus second lens which
is likewise convex towards the front;

(c) A divergent cemented doublet meniscus compo-
nent which is convex towards the front and whose ce-
mented surface is convex towards the rear;

(d) A cemented doublet meniscus component which is
convex towards the rear and whose cemented surface is
convex towards the front;

(e) A single bi-convex rear lens.

An objective of this type has been described in the
United States patent specification 2,836,102.

I have found from calculations and measurements that
a surprisingly well corrected objective of this type for
photographic and projection purposes with a relative aper-
ture up to F:1.3 and a field up to 45° can be obtained
by selecting the radii of curvature (r_1–r_{12}) of the several
lens surfaces, the axial distances (d_1–d_{11}) between such
surfaces, the refractive indices (n_d) and the Abbe-num-
bers (ν) of the several lens elements to substantially have
the following numerical values:

[f=100, F:1.3]

radius of curvature r	axial distance d	refractive index n_d	Abbe number ν
r_1 =+83.496	d_1 =8.75	1.6780	55.5
r_2 =+202.98			
r_3 =+70.207	d_2 =0.1		
r_4 =+132.34	d_3 =7.53	1.6910	54.8
	d_4 =0.6		
r_5 =+49.059	d_5 =18.98	1.6393	44.9
r_6 =−319.48	d_6 =4.70	1.72825	28.3
r_7 =+26.951	d_7 =20.19		
r_8 =−44.198	d_8 =2.35	1.54072	47.2
r_9 =+81.438	d_9 =12.74	1.7170	47.9
r_{10}=−74.480	d_{10}=0.1		
r_{11}=+263.439	d_{11}=6.86	1.7340	51.1
r_{12}=−97.021			

Fig. 1 of the drawing shows an objective in accordance
to my invention;

Figs. 2, 3 and 4 are curves illustrating in the usual

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manner the spherical aberration and the unsatisfied
amount of the sine-condition (Fig. 2); the astigmatism
(Fig. 3 in which the line drawn in full represents the
sagittal focal plane and the dotted line represents the
tangential focal plane) and the distortion (Fig. 4). From
the curves it may be easily recognized that the objective
according to my present invention provides a substantial
improvement over earlier types of similar design.

The spherical longitudinal abberration is lower than
.002 f for all zones. The maximum distortion is about .002
f whereas the separation between the sagittal and the
tangential foci is less than .001 f for all incidence angles.

The chromatic difference in magnification between the
c- and g-line (lateral color) amounts to .0023 f.

It will be understood by those skilled in the art that
certain deviations from the exact values given hereinbe-
fore for the radii of curvature, glass thickness, axial dis-
tances and grades of glass may be applied without the
superb quality of my lens being destroyed. More parti-
cularly, it is possible to select a different value for the
radius of curvature of a surface provided that the refrac-
tive index difference between the materials on both sides
of the surface is so changed as to maintain the refrac-
tive power of the surface substantially constant.

What I claim is:

A high aperture objective of the Gauss-type which is
made up of the following five components comprising
seven elements, viz. from the front to the rear, a single
convergent meniscus front lens which is convex towards
the front, a single convergent meniscus second lens which
is likewise convex towards the front, a divergent ce-
mented doublet meniscus component which is convex
towards the front and whose cemented surface is convex
towards the rear, a cemented doublet meniscus compo-
nent which is convex towards the rear and whose ce-
mented surface is convex towards the front, a single bi-
convex rear lens, the numeral data of said objective
being substantially as follows:

(f=100)

radius of curvature r	axial distance d	refractive index n_d	Abbe number ν
r_1 =+83.496	d_1 =8.75	1.6780	55.5
r_2 =+202.98			
r_3 =+70.207	d_2 =0.1		
r_4 =+132.34	d_3 =7.53	1.6910	54.8
	d_4 =0.6		
r_5 =+49.059	d_5 =18.98	1.6393	44.9
r_6 =−319.48	d_6 =4.70	1.72825	28.3
r_7 =+26.951	d_7 =20.19		
r_8 =−44.198	d_8 =2.35	1.54072	47.2
r_9 =+81.438	d_9 =12.74	1.7170	47.9
r_{10}=−74.480	d_{10}=0.1		
r_{11}=+263.439	d_{11}=6.86	1.7340	51.1
r_{12}=−97.021			

where r_1 to r_{12} are the radii of curvature of the refractive
lens surfaces, d_1 to d_{11} are the axial distances between
such surfaces, n_d is the refractive index and ν is the Abbe
number of the lens elements.

No references cited.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,985,071   May 23, 1961

<div align="center">Johannes Becker</div>

It is hereby certified that error appears in the above numbered pat-
ent requiring correction and that the said Letters Patent should read as
corrected below.

In the drawings, Fig. 4, for "-.002f" and "+.002f" read
-- -.2% -- and --+.2% --, respectively; column 2, lines 10 and
11, for ".002f", second occurrence, read -- .2% --.

Signed and sealed this 27th day of March 1962.

(SEAL)
Attest:

ERNEST W. SWIDER   DAVID L. LADD
Attesting Officer   Commissioner of Patents